PATENT SPECIFICATION

727,903

Date of Application and filing Complete Specification : April 2, 1952. No. 8371/52.

Application made in United States of America on April 10, 1951.

Complete Specification Published : April 13, 1955.

Index at acceptance: -Class 130, 1(2:4), P.

COMPLETE SPECIFICATION

Tobacco Sheet Material, Method of and Apparatus for making the same

We, AMERICAN MACHINE & FOUNDRY COMPANY, a Corporation organized and existing under the laws of the State of New Jersey, United States of America, located at 511, Fifth Avenue, New York City, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to improved tobacco sheets, films, webs, strips and filaments, and to improved methods of producing the same.

The manufacturer of tobacco products generally buys tobacco in the form of whole leaves as removed from the tobacco plant by the farmer. In processing this tobacco, the stem is frequently first removed and then further processing proceeds as desired. In the case of a cigarette manufacturer, this processing includes ageing, blending, casing, cutting the strip, which is the tobacco leaf portion or portions remaining after removal of the stem, into shreds and then drying, cooling and screening the shredded tobacco, followed by packaging. In all these operations, which involve much handling of the tobacco, waste fines and dust are formed. At the present time these waste materials, stems, field scrap (farm damaged leaves), fines and dust have essentially no value to the tobacco manufacturer, and are sold to manufacturers of fertilizers, insecticides, etc., at a fraction of a cent per pound. Much of this waste tobacco material is of good quality from a smoking standpoint. Indeed it is believed that this waste tobacco material contains a disproportionately high percentage of the very best quality smoking tobacco, since the latter comprises the thinnest, lightest, most friable leaves which would most readily break up into fine particles and dust on handling. These high quality fines are useless now only because of their physical form. A technique for processing this good tobacco into a form which would render it usable in smoking articles without essential change in its smoking characteristics would therefore be attractive to a tobacco manufacturer because it would increase the yield, and of course reduce manufacturing costs.

It has been suggested previously that tobacco sheets and films be made by wet milling a mixture of tobacco in water to form therefrom a slurry which can be converted, as by any well-known casting and drying method, into continuous self-supporting products (that is, products which can be handled like natural leaf tobacco), such as sheets and films.

Other attempts to solve the problem of forming a satisfactory tobacco sheet material could be cited, such as by forming tobacco paper using well-known paper-making techniques. However, despite these attempts, little success has been achieved, and to our knowledge, none of these processes has ever been used commercially.

The present invention constitutes a solution to the problem of converting tobacco materials into webs, films, sheets or filaments which can be used in the same manner as natural leaf tobacco in tobacco products such as cigarettes, cigars and the like. Films and webs, strips, sheets and filaments, made in accordance with our invention, are elastic, flexible, tough, self-supporting and continuous, and possess dry and wet strengths comparable to that of natural leaves or pieces of tobacco, and in general retain substantially all natural characteristics and properties of tobacco, including color, aroma, and taste on smoking. This is necessarily true, since in accordance with our invention, the natural tobacco raw material is never subjected to any radical treatment, but is merely dry ground. The dry ground particles are adhered together into the form of a sheet or strip in a novel manner according to the in-

vention by a small proportion of a film-forming material, preferably a specially developed edible adhesive, which has no deleterious effect upon the ultimate consumers, and does not change the characteristic properties of the tobacco thus processed. It will be evident, therefore, that the invention alters only the physical form of the tobacco used as the raw material.

The resulting tobacco sheet material has a high ratio of surface area to mass which causes it to burn more completely than natural tobacco of the same type would when used in smoking articles. This results in a smoother, milder, less irritating smoke.

The characteristic mildness of the smoke from tobacco sheets or strip made according to the invention is especially significant when certain harsh, low grades of tobacco are used as the raw material. Thus, the invention enables a quality improvement in low grade tobacco sufficient to permit the use of the tobacco sheets or strip produced thereby in high quality smoking articles.

The strong, flexible nature of the reconstituted tobacco sheet produced in accordance with the invention yields long shreds, when used in a cigarette "blend", thus tending to minimize the quantity of objectionable "shorts" which fall out of the end of a cigarette or get onto a smoker's tongue, and which may tend to cause non-uniform cigarettes. The invention, therefore, contributes to decreased manufacturing costs by simplifying plant operations, and by reducing the amount of good tobacco material which is presently discarded as waste primarily because its physical form makes it unusable in the blend. In addition, the invention effects a quality improvement in cigarettes, since cigarettes containing shreds of tobacco or strip made in accordance with the invention, have less tendency to lose "shorts" from the ends than have cigarettes containing only natural tobacco shreds. It has also been observed that cigarettes containing tobacco sheet or web material strip made in accordance with the invention are milder, smoother and less irritating than standard blend cigarettes. It is believed that this results from the poly-particulate structure of our novel strip which gives a very high ratio of surface to mass the extreme porosity, providing ready ignition and more complete burning. If desired, whole leaf tobacco or tobacco strip may be used instead of tobacco fines and tobacco dust in forming our novel tobacco sheet or film material.

It is an object of our invention to provide an apparatus for an improved method of making tobacco sheets, strips, webs, films or filaments, wherein fine tobacco particles such as tobacco dust are adhered to both faces of a web of film-forming material and form an integral part of the composite tobacco material produced.

It is a further object of our invention to provide an apparatus for an improved method of making self-supporting, continuous flexible tobacco sheets, webs and the like in which a layer of tobacco dust is coated with a thin layer of a film-forming material, the exposed surface of which is also coated with tobacco dust to form a composite tobacco sheet material consisting primarily of tobacco dust.

It is a further object of the invention to make it possible to convert certain types of tobacco which normally are unsuitable for handling and processing into smoking articles by converting such tobacco into thin, self-supporting, tough, porous sheet form in which such tobacco in small particle size is adhered to both surfaces of a thin web of film-forming material to form thereby a composite tobacco sheet material consisting principally of tobacco

It is a further object of the invention to produce novel smoking articles, such as cigarettes, containing as a part of the cigarette tobacco filler shredded tobacco sheet material or strip produced in accordance with the invention. Such cigarettes are milder, smoother, and less irritating than standard blend cigarettes. This is believed to be due to the poly-particulate structure of the tobacco sheet material or strip which gives a very high ratio of surface to mass and extreme porosity, providing ready ignition and more complete burning.

According to the present invention there is provided a method of forming a self-supporting continuous composite tobacco sheet including depositing a first layer of finely divided tobacco particles upon a film-forming surface, coating the first layer of tobacco particles with a layer of film-forming material, and depositing a second layer of finely divided tobacco particles upon the exposed wet surface of the film-forming material to form the composite tobacco sheet.

According to the present invention there is also provided a self-supporting continuous composite tobacco sheet produced according to the foregoing method comprising a central supporting film of a naturally adhesive film-forming material, which film is coated on both surfaces with substantially uniform layers of finely divided tobacco particles adhered thereto by the natural adhesive properties of the film.

According to the present invention there is also provided apparatus for forming a self-supporting continuous composite tobacco sheet including a movable film-forming surface first means for adhering a layer of finely divided tobacco particles to such surface, second means for applying a film of a film-forming material upon the tobacco par-

ticles adhering to the film-forming surface, a device for applying a layer of finely divided tobacco particles upon the exposed wet surface of the layer of film-forming material, and a dryer for drying the composite layer to form the composite self-supporting tobacco sheet.

In order that the invention may be clearly understood reference will now be made to the accompanying drawings, in which one main embodiment and two modifications of the invention are illustrated by way of example; and in which:

Fig. 1 is a side elevation of a preferred form of apparatus according to the present invention, supporting or framing means being omitted:

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1:

Fig. 3 is a sectional view taken on line 3—3 of Fig. 1:

Fig. 4 is an end elevation as seen from line 4—4 of Fig. 1:

Fig. 5 is a view showing diagrammatically a modified method of producing our novel tobacco sheet material; and

Fig. 6 is a view showing diagrammatically a modified method of finishing our novel tobacco sheet material and preparing it for use.

Referring to the drawings, Fig. 1 shows a preferred form of apparatus for forming the novel tobacco sheet material in accordance with the invention, and for carrying out the steps covering the preferred method of our invention. Numeral 10 designates a device for forming a wetting solution 15 which is applied to endless belt 12, after which fine tobacco particles are substantially immediately applied thereto as by blowing the particles thereupon. It will be seen that the wetting solution 15 is a fluid which can be applied to the belt 12 and which acts as a temporary holding agent for the tobacco dust applied to the belt 12. Any suitable mixing device may be used for forming wetting solution 15.

A substantially uniform layer of fine tobacco particles such as tobacco dust is adhered to belt 12. A method, which has been found satisfactory for adhering fine tobacco particles to belt 12 is to wet belt 12, as described above and set out in greater detail hereinafter. It has been found that this technique insures that fine tobacco particles coated upon belt 12, will cling thereto and form a substantially uniform layer. This is necessary in an apparatus such as shown in Fig. 1, where fine tobacco particles are deposited upon the exposed surface of the lower lap of belt 12. It is also highly desirable in a case where a longer belt 12 is used and fine tobacco particles are applied to the upper lap thereof. This is due to the fact that if a loose layer of tobacco particles were applied to belt 12, during the subsequent operation of spraying a layer of film-forming material upon the layer of tobacco particles, the latter in all probability would be dispersed, or a large proportion thereof would be removed from belt 12 and hence the desired results would be unobtainable. In the apparatus such as shown and in performing the preferred method of the invention, a substantially uniform continuous layer of tobacco is adhered to belt 12 and very satisfactory results are secured.

Solution 15 is piped into a container 14 and is pumped or flows by gravity to a device 20 of suitable design, which atomizes it and sprays it upon belt 12 which is preferably driven continuously. Device 20 in the illustrated embodiment travels back and forth relative to belt 12 in applying wetting solution 15 thereupon. If desired, a stationary spraying mechanism, provided with a plurality of stationary spray heads so disposed as to apply a substantially uniform coating of solution 15 on belt 12, could be used.

When sprays are used as application means, it may be desirable to recover the spray droplets which do not adhere to the belt surface. This may be done by a hood surrounding device 20 and connected to a suitable air-droplet separating device by a suitable conduit.

In order to control the amount of wetting solution 15 deposited on belt 12, a suitable metering device 13 of conventional design is employed. This may be a metering pump or the combination of a flowmeter with a control valve. Compressed air, supplied through conduit 22 in known manner to device 20, atomizes the solution for application upon belt 12 in a uniform thin layer. In order to secure uniform distribution of wetting solution on belt 12, device 20, as before stated, is mounted for movement back and forth across belt 12. In the apparatus illustrated, the desired movement of device 20 is secured by means of an interrupted thread drive shaft 24 which engages with and drives carriage 26 supporting device 20. Shaft 24 is driven by a motor or other suitable source of power during the operation of the apparatus. As shown in Fig. 1, spraying device 20 is located beneath belt 12. This arrangement makes it possible to use a shorter belt and conserve space. Obviously, if desired, belt 12 could be longer, and wetting solution 15 could be applied to the upper lap thereof instead of the lower lap, as shown, and the same results obtained.

Wetting solution 15 is principally a water solution and its use is designed primarily to provide a wetted surface to which a layer of tobacco will cling until it is covered with a layer of a suitable film-forming substance, referred to hereinafter in detail. Solution 15,

as used herein, contains a small amount of low viscosity carboxymethylcellulose, to assist in bonding the tobacco particles to the main strength-giving film. This may be omitted if desired. The concentration of CMC (carboxymethylcellulose) used in solution 15 preferably ranges between 0.5 per cent. and 1½ per cent. by weight and the thickness of the film solution 15 applied preferably ranges between 3 and 10 mils. But other concentrations and thicknesses can be used. If desired, and in order to aid solution 15 in wetting belt 12, a small quantity of a suitable detergent is used as an ingredient of solution 15. One tenth of one per cent. of "Dreft", Registered Trade Mark, a synthetic detergent, in the solution 15, has proven to be satisfactory.

Belt 12 moves in the direction of arrow A. It is supported upon driving pulley or drum 28 and driven pulley or drum 30 on shafts 32, 34, respectively, shaft 32 being driven continuously from a motor or other suitable source of power and at a speed commensurate with the proper practice of the invention.

Following the application of solution 15 to belt 12, the belt moves to a tobacco-particles-applying zone where a device, designated generally 36, applies fine particles of tobacco to the wetted portion of the surface of belt 12. Fine tobacco particles in quantity greater than that which will adhere to the wetted surface of belt 12 is blown thereupon by an air blast nozzle 38 fed by a conduit 40 from a conventional type of dry material feeding mechanism 42. Any conventional type of feeder may be employed as long as it can be used for the efficient and effective distribution and application of fine tobacco particles onto belt 12. Blower 41 connected to the operating conduit system of feeding mechanism 42, forces air through chamber 44 where fine tobacco particles, fed by a screw conveyor element (not shown) in mechanism 42, is taken up and sprayed or blown upon the wetted portion of belt 12. It has been found that an air flow ranging between 3,300 and 5,000 cubic feet per minute at the nozzle tip gives satisfactory results. An electric vibrator 46, attached to the hopper 48 of feeding mechanism 42, assists in the proper movement of fine tobacco particles to the feeding screw conveyor element (not shown) in hopper 48. As the result of the operation of device 36, a substantially continuous or unbroken layer of fine tobacco particles is deposited upon the wetted portion of the surface of belt 12 where it remains as the movement of belt 12 brings it to and passes it through the next operating station where a thin layer of film-forming solution is applied to the tobacco particles adhering to belt 12.

A large excess of tobacco particles is applied by nozzle 38. Tobacco particles which do not adhere to belt 12 are recovered by a recovery system including a hood 45 surrounding nozzle 38 and a suction conduit 49 connected to a suitable tobacco-air separating unit, such as a conventional "Cyclone" Separator (not shown), or a bag filter. Particles recovered are returned to hopper 48 for re-use. As shown in Fig. 1, the nozzle of unit 20 preferably is directed away from tobacco particles applying mechanism 36. This arrangement insures that tobacco particles, issuing from nozzle 38, will be substantially free of the danger of being coated by wetting solution 15 which might render it less suitable for recycling and re-use.

Spraying or blowing nozzle 38 may be one of the plurality of nozzles extending transversely across the path of travel of belt 12 or a single nozzle extending entirely across the path of movement of belt 12. As shown in the illustrated embodiment, however, it consists of a single nozzle 38 attached to conduit 40 and mounted on a carriage 50 supported upon and moved back and forth relative to belt 12 by interrupted thread shaft 53 of conventional design. See Fig. 2. The ends of shaft 53 are supported in bearings in side frames 6 and 8 of the machine. Attached to one end of shaft 53 is a pulley 57 on which runs a driving belt 59 running on a driving pulley (not shown) driven by any suitable source of power, as a motor (not shown) or main drive shaft of the apparatus (not shown). Stabilizing rods 55, having their ends attached to frames 6 and 8, pass through horizontal parallel bores in carriage 50 and maintain the latter and nozzle 38 in proper operative position during its continuous travel back and forth relative to belt 12 while the apparatus is in operation. The portion of belt 12 which is coated with tobacco particles next moves to a coating zone where a thin layer of suitable film-forming material is applied over the layer of tobacco.

In forming the novel reconstituted tobacco sheet or web material described hereinabove, the film-forming material used in making the base web of our sheet or web material can be any film-forming material which possesses adequate strength and which has natural adhesive qualities so that it retains the tobacco particles well. It is also essential that a film-forming material be used which has adhesive qualities and which on smoking the final reconstituted tobacco sheet or web does not cause an unsatisfactory taste, aroma or harshness. Suitable film-forming materials are water-soluble salts of carboxymethylcellulose and carboxymethylhydroxyethylcellulose or carboxymethylcellulose and carboxymethylhydroxyethylcellulose which are respectively cellulose glycolic acid and cellulose hydroxy glycolic acid, the latter two being insoluble in water but which are capable of being formed into stable water dispersions in a manner described and

claimed in British Patent No. 698948.

These dispersions are capable of being cast to form a wet web, which when dried, becomes a self-supporting, water-insoluble film. The terms "CMC" and "CMHEC" where used herein, mean the free acid forms of cellulose glycolic acid or carboxymethylcellulose, and cellulose hydroxy glycolic acid or carboxymethyl hydroxyethyl cellulose, respectively.

If desired, a cross linking agent, such as glyoxal, may be added to improve further the water resistance of the already water resistant CMC. If desired, a humectant may be added to the film-forming dispersion.

Typical dispersions can be prepared as follows: a 1/16 inch diameter stream of a 3.75 per cent high viscosity sodium carboxymethylcellulose solution in water is extruded into about twice its weight of 20 per cent sulphuric acid solution. The sodium carboxymethylcellulose solution forms threads which are allowed to stand in the acid two hours to complete the acidification of the sodium carboxymethylcellulose. The threads of reacted carboxymethylcellulose are then removed from the acid by means of a suitable screen, etc. The insoluble carboxymethylcellulose is then washed with a stream of water until the pH of a dispersion formed by processing a sample of the carboxymethylcellulose threads in a Waring Blendor is 2.4. A "Waring Blendor" is a very common type of high speed mixing device. It consists of a base having a vertically positioned motor with a shaft extending upwardly therefrom, adapted to be detachably coupled with a driven shaft member rotaably mounted in the base of a glass receptacle. Attached to the driven shaft and located within and proximate the bottom of the glass receptacle are several knives or mixing members. The motor rotates these knives at from 15-17 thousand r.p.m. in order to effect mixing and blending. At this point, the washing may be discontinued. The carboxymethylcellulose, which is now in the form of semi-solid, long, gelatinous strands, is then ground in a colloid mill, Waring Blendor or similar device to produce a fine dispersion of carboxymethylcellulose in water. In general, we may use a technique similar to that disclosed in British Patent No. 698948.

In forming satisfactory aqueous carboxymethylcellulose dispersions, it is found that good results are obtained when the concentration of the sodium salt of carboxymethylcellulose solution ranges between 2 and 8% by weight, and the final sulfuric acid concentration is between 5 and 25%. The time of acidification may vary over wide limits, as may the washing time. The pH of the final carboxymethylcellulose dispersion may also vary from about 1.5 to 5.0.

To make a dispersion suitable for coatings, the concentrated carboxymethylcellulose, prepared as described above, may be diluted to the desired concentration by the addition of water, and if desired, suitable quantities of a humectant, such as glycerine, can be added, and if desired, glyocal may also be added.

The techniques described for forming aqueous dispersions of cellulose glycolic acid are followed in making aqueous dispersions of carboxymethyl hydroxyethyl cellulose which for our purpose has characteristics similar to those of cellulose glycolic acid. A satisfactory dispersion of acid carboxymethylhydroxyethyl cellulose for use in forming films, web, sheets and the like, was made as follows: The sodium salt of carboxymethylhydroxyethyl cellulose was dissolved in water to form a thick paste. The paste was extruded through a 1/16 inch diameter orifice into 20% sulphuric acid and was permitted to stand in the acid for two hours. The hardened spaghetti-like threads of the insoluble acid form of carboxymethyl hydroxyethyl cellulose were removed from the acid, drained and washed with running water for twenty minutes. The washed threads were then dispersed in a manner similar to that described above to form an aqueous dispersion.

The amount of film-forming material applied depends on the physical strength desired in the final sheet or strip. It has been found that when an amount of dispersion equivalent to 0.8 gram CMC per square foot of sheet is used, the dry breaking strength of the final sheet is about 700 grams per inch of width. In this sheet the film-forming solution 51 was applied in an amount such that the sheet contained 0.15 gram per square foot of low viscosity CMC. This sheet was adequately strong to pass through the same process and the processing equipment used for natural leaf tobacco without any significant mechanical degradation. Obviously, if greater or less strength is required, the amount of film-forming material may be adjusted to obtain the desired strength.

The dispersion, designated generally 51, is contained in a suitable container 52 having a conduit 54 connected to tube 55 of a metering pump 56, the rotor of which (not shown) is driven by a belt 58 from a suitable source of power such as a motor (not shown). Belt 58 runs on pulley 60 attached to rotor shaft 62. Any conventional type of metering pump may be used so long as a constant quantity of dispersion is forced through conduit 64 to and through nozzle 66 of applying device 70. Compressed air supplied through conduit 64' to device 70 atomizes the solution for application in a uniform thin layer. The pump shown diagrammatically in Fig. 1 may be similar in construction and operation to that illustrated in United States Patent

No. 1,848,042, and includes a rotor (not shown) supporting a plurality of squeeze rollers (not shown) which progressively squeeze tube 55 and thus pump metered quantities of dispersion 61 to nozzle 66. Applying device 70 includes a carriage 68 supporting nozzle 66. Carriage 68, which may be similar in construction and operation to carriage 26, is mounted on interrupted-thread rotary shaft 69 suitably supported in side frames 6 and 8 of the machine for movement back and forth above belt 12, in order that film-forming material may be sprayed by nozzle 66 upon the layer of tobacco particles adhering and clinging to the wetting solution 15 of belt 12. If desired, a hood (not shown), similar to that used in connection with spraying device 20, may be provided for recovering sprayed dispersion 51 not actually forming the film covering the layer of tobacco particles.

Following the application of the thin layer of film-forming material 51, and while it is still wet, belt 12 moves the wet layer into a tobacco-particle-applying zone where a tobacco-particle depositing device, designated generally 72, such as a travelling blowing nozzle 74, applies a heavy coating of fine tobacco particles to the wet exposed adhesive surface of the layer of film-forming material 51. Excess tobacco particles are caught by hood 76, attached to the machine frame by brackets 71, and conducted by a suitable suction system including a conduit 78 to the tobacco-separator referred to hereinabove for re-use. It will be noted that hood 76 is provided with a transverse slot 80 through which nozzle 74 projects into tobacco dust applying position to belt 12 and along which it travels as it moves back and forth across belt 12. The desired movement of carriage 75, which supports nozzle 74 in the illustrated embodiment, is secured by an interrupted thread driven shaft 77 of conventional design driven from a suitable source of power continuously during the operation of the machine. Tobacco particles are fed by a vibratory feeder, designated generally 82, which is vibrated in known manner during the operation of the machine by a motor 84 attached thereto. Tobacco fed from feeder 72 is delivered into chute 86 whence it is conducted into blower 88 of suitable conventional design, and forced with air delivered by blower 88 through conduit 73 and nozzle 74 and onto the wet exposed surface of the layer of material 51, as stated above.

Belt 12 preferably is provided with a smooth polished impermeable surface. Belt 12, as used herein, is made of metal and for that reason is subject to expansion and contraction during its passage through dryer 90 which removes moisture from the composite web carried thereby.

It has been found that unless the dimensions of belt 12 at certain stages of the drying process are controlled, undesirable checks and cracks may be formed in the web W. It is believed that these checks and cracks occur when belt 12, carrying an already solidified web W, is allowed to continue to rise in temperature, thus expanding the belt. Since the solidified web W adheres firmly to the belt and cannot stretch appreciably before cracking, expansion of belt 12 could cause the observed cracks.

Since web W is normally solidified and set before it is completely dry, belt 12, carrying web W, normally is exposed to heat after solidification of the web takes place, in order to complete the drying. This heating expands the belt and could cause checks and cracks. It has been found that if the belt is heated before it enters the portion of dryer 90 where the web W has been solidified, the aforementioned checks and cracks are substantially prevented. Therefore, in order to insure that the composite tobacco sheet material web W will be substantially free of checks and cracks which would be undesirable, means are provided for heating belt 12 in order to expand it relative to the adjacent tobacco layer prior to its reaching the point in dryer 90 where solidification of web W occurs. As shown in Fig. 1, dryer 90 may be divided into several zones in which different conditions of temperature, air velocity and humidity may exist. In addition, individual control of temperature and/or velocity may be provided for the spaces faced respectively by the top and bottom of the belt in each zone. Thus, by adjusting the rate of heat transfer to the side of the belt not covered by web W and by adjusting temperature and/or air velocity, the temperature of the belt may be controlled thus enabling the prevention of checks and cracks in web W as explained above. Any suitable conventional type of control valve may be used for securing the proper heat transfer required in each zone I, II and III and controlling this independently in each zone. A suitable valve, indicated generally at 91, is a thermally actuated valve, the degree of opening of which is controlled by the temperature of the air passing through the exhaust ducts of each dryer zone. In the case of a gas-fired dryer valves 91 control the quantity of gas being burned in each zone.

If desired, the belt may be pre-heated in order to expand it by a heating element suitably mounted on the frame of the machine. Heating element 110, which may be of any suitable conventional design, extends transversely across belt 12, as indicated in Fig. 1, and when heat is generated therein, the heat results in expansion of belt 12 such that cracks and checks in web W are prevented, as stated above.

When heating element 110 is provided, the amount of heat transfer to the belt itself in dryer 90 may be less than when element 110 is not provided since the desired expansion of belt 12 has already been effected by element 110. On the other hand, under some conditions, it may prove desirable to again heat belt 12 to insure its proper expansion before it reaches the point in dryer 90 where web W is solidified.

Located between hood 72 and dryer 90 along the path of travel of belt 12, are flexible blades 81, preferably formed of rubber or thin flexible steel, which bear against the upper surface of belt 12. The positions of the inner edge of each of these blades 81 determine the width of the final web W since these blades scrape off and remove the edge portions of the web. In this manner, the width of the web passing into dryer 90 is maintained substantially constant.

Blades 81 are mounted on brackets 83 adjustably secured in slots in brackets 85 suitably attached to the side frame 6 and 8 of the machine. The position of each blade 81 can be adjusted as desired by loosening wing nuts 87, moving brackets 83 inwardly or outwardly, and then tightening the wing nuts in the desired adjusted position.

Upon emergence of the portion of belt 12 which carries web W from dryer 90, it moves beneath a brushing unit designated generally 120 which includes a rapidly rotated brush 122 mounted on a continuously driven shaft 124, suitably journalled for rotation in the side frames of the machine 6, 8, and driven in any desired maner by a motor or other source of power (not shown). Unit 120 also includes a hood 126 supported in any desired manner by the side frames of the machine and extending transversely across belt 12. Hood 126 preferably has mutually upwardly tapered sides, and ends (not shown), and has connected thereto, as indicated in Fig. 1, a suction conduit 128 connected to the above referred to tobacco-air separator, such that loose tobacco particles, bushed from the top surface of web W, are conducted from hood 126 through conduit 128 and returned for re-use.

After the brushing operation just described, belt 12 moves web W through a moistening device designated generally 140. This device can be employed for the sole purpose of applying moisture, as by spraying water, upon the exposed surface of the brushed composite web W, or, as shown in Fig. 1, it can perform the dual function of rehumidifying and applying a suitable dye to the exposed surface of the web in order that the resulting web product may suit the color requirements of the manufacturer who is to use the product. In the embodiment selected for purposes of illustration, device 140 consists of two sets of spray nozzles, 142 and 144 projecting downwardly from conduits 148, 146 respectively, extending transversely of belt 12. The ends of conduits 146 and 148 are suitably supported in side frames 6 and 8 of the machine, Fig. 3. Conduits 146 and 148 are connected by a Y unit 150 to a mixing valve 160. A conduit 162 connects valve 160 to a source of supply of water 163. A conduit 164 connects valve 160 to a source of supply of dye 165. Conduit 162 is provided with a metering device 166, and conduit 164 is provided with a metering device 167. In this manner, the metered quantities of water and dye flowing from containers 163 and 165 respectively through valve 160 to conduits 146 and 148 can be controlled as desired by proper manipulation of mixing valve 160. The flow of dye to nozzles 142 and 144 may be stopped completely. The same is true with respect to water flowing from container 163. As shown in Fig. 1, the flow of water or dye to nozzles 142 and 144 is effected by gravity. Obviously if desired, this could be accomplished by a pump. A compressed air conduit 168 operatively connected to valve 160 provides compressed air for atomizing the mixture of water and dye, or water or dye alone, depending upon the fluid flowing into "Y" unit 150 from containers 163 and 165, or 163 or 165 alone, as the case may be. Compressed air is furnished to conduit 168 from any suitable conventional source of supply (not shown).

Under some conditions, the degree of drying accomplished in dryer 90 can be controlled such that web W can be removed from belt 12 without remoistening by device 140. Under these conditions, device 140 may be used to apply dye only; or if dye is not required, device 140 may be eliminated entirely.

The moistened composite tobacco sheet or web material W is removed from belt 12 by means of a conventional type of doctor blade 180. The composite tobacco sheet material web W after being removed from the surface of belt 12, is moved therefrom onto an endless conveyor designated generally 190. As shown in Fig. 1, located between the delivery end of belt 12 and the receiving end of conveyor 190, is a dye applying device designated generally 182 which consists of a carriage 184 mounted for movement back and forth relative to the undersurface of web W as the latter moves onto conveyor 190. This movement is effected by means of an interrupted threaded shaft 186 similar in construction and operation to shafts 53 and 77, which during the operation of the machine is driven continuously so that so long as web W is being delivered from belt 12, spraying device 182 applies dye to the under-surface of web W. Of course, if it is not desired to apply dye to the under-surface of web W, the rotation of shaft 186 is

prevented by suitable means (not shown), and hence the movement of carriage 184 is also prevented. In order to provide for this operation, means, such as a valve (not shown) are provided for preventing the flow of dye and compressed air to nozzle 188. Dye is conducted to nozzle 188 through flexible conduit 189 from a source of supply, such as container 165 and a suitable metering device, similar in construction and operation to metering device 167. Compressed air for atomizing purposes is conducted to nozzle 188 by means of flexible conduit 191 from any suitable conventional source of supply (not shown). Suitable hoods (not shown) may be provided for use with devices 140 and 182 for recovering dye spray droplets, thereby preventing possible waste of the relatively expensive dye. The under-surface of the web W may if desired be moistened only instead of dyed, or may be moistened and also dyed.

Conveyor 190 preferably comprises an endless travelling belt 192 formed of canvas or like material. Belt 192 runs on drums 194 and 196. Drum 194 is attached to driving shaft 198 which is driven in any desired manner as by a motor or from the main shaft of the machine. Shaft 198 is rotatably supported in bearings (not shown) in side frames 6 and 8 of the machine. Drum 196 is mounted on a driven shaft 200 also rotatably supported in side frames 6 and 8 of the machine. Belt 192 carries moistened web W through a dryer 202 of suitable conventional design in which, as the web passes therethrough, moisture is removed until, as the web leaves the dryer, the desired moisture content is present in the web. This may be from 10 to 15% moisture by weight. Obviously the dryer may be so adjusted in known manner as to control the amount of moisture contained in web W as it leaves the dryer and is delivered by conveyor 190 to a roller 204 mounted on a continuously driven shaft 206. As web W is fed positively and continuously from continuously moving conveyor 190, it passes beneath a rotating brush 208 supported by a continuously driven shaft 210. Shafts 206 and 210 are also rotatably supported in side frames 6 and 8 of the machine. Shaft 206 is driven by a pulley 207 on which runs a driving belt 209 running on a driving pulley (not shown) driven from any suitable source of power. Brush 208 performs the function of removing from the surface of the composite tobacco sheet material web W any loose particles of tobacco dust which may be present therein. These are received within a hood 212, which is attached to side frames 6 and 8 of the machine in any suitable manner. A suction conduit 214 connected to the air-tobacco separator above referred to delivers all reclaimed tobacco dust to a suitable receptacle for re-use.

After being brushed, web W is passed between a continuously driven roller 216 mounted on a continuously driven shaft 218 and a coacting, rotating brush 220 attached to continuously driven shaft 222. Shaft 218 is driven by a pulley 217 by a belt 219 running on a suitably driven driving pulley (not shown). Brush 220 is enclosed in a suction hood 224 similar in construction to hood 212, and by means of a suction conduit 226, loose tobacco is removed from the under-surface of web W and conducted to the above-referred-to receptacle (not shown) for re-use. If desired, finished web W having substantially uniform layers of finely divided tobacco adhering to the surfaces of the film-forming material may be rolled into reels for further processing. It is preferred, however, to cut it to a desired size since this enables it to be handled more readily and packed for shipment or for immediate use in a plant, such as a cigarette factory. As indicated in Figs. 1 and 4, a gang of equally spaced rotary knives designated generally 229 may be used for cutting web W longitudinally in the direction of its travel. Gang of knives 229, shown in Fig. 4, is made up of five knives 230 secured to continuously rotating shaft 232 journalled for rotation in side frames 6 and 8 and driven by means of a pulley 234 and belt 236 from a motor or other suitable source of power such as the main drive shaft of the machine (not shown). Obviously more or less knives 230 could be used, depending upon the width of strips desired. Increasing the number of knives 230 and closely spacing them, web W can be cut into filaments or shreds. Knives 230 coact with grooves in a metal roller 238. Roller 238 is mounted on a shaft 240 journalled in side frames 6 and 8 and driven in a manner similar to shaft 232. Strips of web are further cut into pieces P, such as shown in Fig. 4, by means of a rotary cutter consisting of a transverse blade 242 mounted on a roller 244 secured to shaft 246 having a pulley 248 on which runs a belt 250 driven from a suitable source of power (not shown). A ledger blade 252 carried by roller 254 on continuously rotated shaft 256 operatively supported in side frames 6 and 8 and driven in a manner similar to that of shaft 246, coacts with blade 242 to cut the pieces which fall into a suitable receptacle (not shown). Since there may be a loosening of tobacco particles at the lines of cut as the result of the cutting operations of knives 230 and 242, and it is desirable to reclaim such tobacco particles for further use, it is preferred to provide a suction reclaiming device indicated generally 260 having a suction conduit 262 operatively associated therewith, which conduit conducts the tobacco dust to the tobacco-air separator for separation and storage. As shown in

Fig. 1, sheets or pieces of the novel tobacco sheet or web material P dropping from transverse cutting blade 242, pass between a plate 264 and suction reclaiming device 260 which has a low suction such that each sheet or piece P is free to continue its fall, but tobacco particles are sucked off and collected for re-use in the manner stated.

In some cases, it is desirable to brush the underside of web W before it is dyed in order to avoid uneven dyeing of the underside and thereby insure uniform coloring thereof. Fig. 6 illustrates diagrammatically the steps involved and suitable apparatus which can be used in carrying out these steps. In Fig. 6, 180 indicates a doctor blade which removes web W from belt 12, whereupon web W moves through a dryer 201 similar in construction and operation to dryer 202, shown in Fig. 1. The underside of web W is then brushed by a brush 220', dye is applied by an applying device, designated generally 182, described herein above, and the web is then passed through dryer 202. Dried web W upon emerging from dryer 202, is moved through slitting and cutting device 229, and any loose fine tobacco particles are removed by device 260 shown in Fig. 1. The finished sheet material is then packed, or processed directly into smoking articles such as cigarettes.

It is believed that the description and operation of the apparatus shown in Figs. 1 to 4 inclusive, will make clear the manner in which a preferred method of forming our novel tobacco sheet or web material is effected. Fig. 5 shows a modified form of method for producing our novel tobacco sheet or web material. In general, the modified method is essentially the same as that described in connection with the apparatus shown in Figs. 1 to 4 and is set forth as follows: Referring to Fig. 5, a film-forming surface similar in construction and operation to belt 12, disclosed in Fig. 1, is wetted as at 350 with a wetting solution similar to solution 15 used in the preferred method. Fine tobacco particles are then applied in excess quantity by a suitable blowing device indicated at 352, which device may be similar in construction and operation to that shown in Figs. 1 and 2. The excess tobacco particles are recovered in the manner described above for re-use. The film-forming surface is then moved to a drying device indicated at 354 in Fig. 5 where the layer of tobacco clinging to the film-forming surface is dried. A thin layer of film-forming material, such as film-forming solution 51 described in the preferred method above referred to, is then applied in a uniform thin layer as at 356 by spraying device such as device 70, over the dried layer of tobacco particles on the film-forming surface. As in the preferred method described hereinabove, a large quantity of tobacco particles are blown as at 358, by a mechanism similar to device 72 shown in Fig. 1, upon the wet exposed surface of the layer of film-forming material, and the excess quantity of tobacco particles is recovered for re-use. The resulting composite web, consisting of a bottom layer of tobacco particles, an intermediate thin layer of flexible film-forming material, and a top layer of tobacco particles, is then dried as at 360 as the result of the film-forming surface being passed through a suitable dryer such as dryer 90 shown in Fig. 1. The steps employed subsequent to the drying operation are the same as set forth in connection with the description of the preferred method. The resulting tobacco sheet or web material is then cut to size and either packed for shipment to a processing plant, or used directly in the formation of smoking articles. If the material is to be used in the formation of cigarettes, it is shredded in any suitable manner and admixed with shredded cigarette tobacco, or can be admixed in sheet or strip form with cigarette tobacco strip, which mixture is shredded before being formed into cigarettes.

In view of Section 9, sub-section (1) of the Patents Act, 1949, we direct attention to the specification and claims of our Application No. 25857/50.

We are aware of the Tobacco Act, 1842 (5 and 6 Vict. Cap 93) and we make no claim to use of this invention in contravention of any of the provisions of that Act. We do however expressly make claim to any use of the invention which may now be in contravention of said Act and which may hereinafter become legal as a result of modification or repeal of said Act as of the date such use becomes legal.

What we claim is:

1. A method of forming a self-supporting continuous composite tobacco sheet including depositing a first layer of finely divided tobacco particles upon a film-forming surface, coating the first layer of tobacco particles with a layer of film-forming material, and depositing a second layer of finely divided tobacco particles upon the exposed wet surface of the film-forming material to form the composite tobacco sheet.

2. A method according to Claim 1, in which the layers of tobacco particles are substantially uniform and the film-forming layer is thin in comparison to the tobacco layers.

3. A method according to Claim 1 or 2, in which the film-forming surface is smooth.

4. A method according to Claim 1, 2 or 3, in which excess and loose tobacco particles are removed from either face or both faces of the sheet.

5. A method according to Claim 4, in which the removal of the excess and loose tobacco particles is effected by brushing.

6. A method according to Claim 4 or 5,

in which the tobacco particles thus removed are recovered for subsequent use.

7. A method according to any of Claims 1 to 6, in which the composite tobacco sheet is dried.

8. A method according to Claim 7, in its appendancy to Claim 4, 5 or 6 in which the excess and loose tobacco particles are removed after the composite sheet is dried.

9. A method according to Claim 7 or 8, in which the film-forming surface is expanded relative to the first layer of tobacco particles prior to the drying of the composite sheet whereby to prevent cracking of the composite sheet.

10. A method according to Claim 9, in which the film-forming surface is expanded prior to the application of the film-forming material to the first layer of tobacco particles.

11. A method according to Claim 7, 8, 9 or 10, including adjusting the humidity of the resulting composite sheet to a moisture content between ten per cent and fifteen per cent.

12. A method according to any of Claims 7 to 10, including moistening either or both of the two layers of tobacco particles after drying the composite sheet.

13. A method according to Claim 12 or according to any of Claims 7 to 10, including dyeing either or both of the two layers of tobacco particles after drying the composite sheet.

14. A method according to Claim 12 or to Claim 13 in its appendancy to Claim 12, including redrying the composite sheet after the moistening step to reduce the moisture content to a predetermined percentage by weight of the composite sheet.

15. A method according to any of Claims 1 to 14 in which a dispersion of cellulosic glycolic acid is formed and the dispersion is applied to the first layer of tobacco particles in order to form the film-forming material.

16. A method according to any of Claims 1 to 14 in which the film-forming material is cellulose glycolic acid.

17. A method according to any of Claims 1 to 14 in which the film-forming material is a water-soluble salt of cellulose glycolic acid.

18. A method according to any of Claims 1 to 14 in which the film-forming material is carboxymethyl hydroxyethyl cellulose.

19. A method according to any of Claims 1 to 14 in which the film-forming material is a water-soluble salt of cellulose hydroxy glycolic acid.

20. A method according to any of Claims 1 to 19 in which the first layer of tobacco particles is adhesively secured to the film-forming surface.

21. A method according to any of Claims 1 to 19 in which the film-forming surface is wetted before the first layer of tobacco particles are deposited thereon.

22. A method according to any of Claims 1 to 21 in which the composite sheet is cut into sheets or filaments.

23. A tobacco sheet material product produced by the method according to any one of the preceding claims.

24. A self-supporting continuous composite tobacco sheet produced by the method of Claim 1 comprising a central supporting film of a naturally adhesive film-forming material, which film is coated on both surfaces with substantially uniform layers of finely divided tobacco particles adhered thereto by the natural adhesive properties of the film.

25. A composite sheet according to Claim 24 in which the film-forming material is thin and flexible.

26. Apparatus for forming a self-supporting continuous composite tobacco sheet including a movable film-forming surface, first means for adhering a layer of finely divided tobacco particles to such surface, second means for applying a film of a film-forming material upon the tobacco particles adhering to the film-forming surface, a device for applying a layer of finely divided tobacco particles upon the exposed wet surface of the layer of film-forming material, and a dryer for drying the composite layer to form the composite self-supporting tobacco sheet.

27. Apparatus according to Claim 26 in which the first means include means for applying a wetting solution upon successive portions of the movable surface.

28. Apparatus according to Claim 27 in which the means for applying the wetting solution include a spraying device.

29. Apparatus according to Claim 28 in which means are provided which are associated with the spraying device for recovering spray droplets for re-use.

30. Apparatus according to Claim 28 or 29 in which the spraying device includes a spray nozzle, and supports are provided for moving such nozzle for application of the wetting solution in a direction transversely to the movement of the film-forming surface.

31. Apparatus according to any of Claims 26 to 30 in which the first means include a device adapted to apply finely divided tobacco particles in a continuous substantially uniform layer.

32. Apparatus according to Claim 31 in its appendancy to Claim 28, 29 or 30, including a hood surrounding the tobacco applying device for preventing wetting of the tobacco particles being applied by such device to the surface by the wetting solution discharged by the spraying device.

33. Apparatus according to any of Claims 26 to 32 in which the dryer includes a plurality of drying zones, the first zone of which applies heat to the underside of the

surface whereby the film-forming surface is expanded prior to the passage of the film bearing portions of the surface through the remaining zones to prevent cracking of the composite sheet as such portions of the surface move through the remaining zones.

34. Apparatus according to Claim 33 in which means are provided in each drying zone for independently controlling the rate of heat transfer to both sides of the film-forming surface, whereby the temperature of the film-forming surface at any point in the dryer can be controlled to prevent cracking of the composite sheet as such portions of the surface move through the remaining zones.

35. Apparatus according to any of Claims 26 to 34 in which the second means is adapted to apply a film of film-forming material which is thin compared to the tobacco layer adhered to the surface.

36. Apparatus according to any of Claims 26 to 35 in which the film-forming surface is endless.

37. Apparatus according to any of Claims 26 to 36 in which means are provided for heating and expanding the surface prior to the movement of the portions of the surface to which finely divided tobacco particles have been adhered into the range of operation of the second means.

38. Apparatus according to any of Claims 26 to 37 in which means are provided for dyeing the layer of tobacco applied to the film-forming material.

39. Apparatus according to any of Claims 26 to 37 in which means are provided for moistening the layer of tobacco applied to the film-forming material.

40. Apparatus according to any of Claims 26 to 39 in which means are provided for removing the composite sheet from the film-forming surface and means are provided for dyeing the layer of tobacco initially adhered to the surface.

41. Apparatus according to any of Claims 26 to 40 in which means are provided for removing the composite sheet from the film-forming surface and means are provided for moistening the layer of tobacco initially adhered to the surface.

42. Apparatus according to Claim 38 to 40 in which the dyeing means include a spraying unit.

43. Apparatus according to Claim 39 or 41 in which the moistening means include a spraying unit.

44. Apparatus according to any of Claims 40 to 43 in which means are provided for reducing the moisture content in the composite sheet to between 10 per cent. and 15 per cent. after such sheet is moistened or dyed, as the case may be.

45. Apparatus according to Claim 44 in which the moisture reducing means include a further drier.

46. Apparatus according to any of Claims 26 to 45 in which brushing means are provided for brushing either face or both faces of the composite sheet at a station or stations respectively along the path of travel of the composite sheet.

47. Apparatus according to Claim 46 in which means are provided which are associated with the brushing means for recovering the tobacco particles brushed from the surface of the composite sheet by the brushing means.

48. Apparatus according to any of Claims 26 to 46 including means for recovering free excess fine particles of tobacco.

49. Apparatus according to Claim 48 in which the recovering means are suction operated.

50. Apparatus according to any of Claims 26 to 47 in which cutting means are provided for cutting the composite sheet into sheets.

51. Apparatus according to Claim 50 in which the cutting means include knives for cutting the advancing portion of the composite sheet longitudinally, and a knife for cutting the longitudinally slit composite sheet transversely into sheets.

52. Apparatus according to Claim 51 in which the knives for cutting the composite sheet longitudinally are rotatable and are arranged closely spaced on a shaft whereby to cut the composite sheet into a plurality of narrow endless strips.

53. Apparatus according to Claim 50, 51 or 52 in which means are provided for recovering fine tobacco particles separated from the composite sheet during the cutting process.

54. Apparatus according to any of Claims 26 to 53 in which means are provided for removing the composite sheet from the film-forming surface after the sheet leaves the dryer.

55. Apparatus according to Claim 26 in which the means for adhering the layer of finely divided tobacco particles to the film-forming surface secure the tobacco particles to the surface temporarily by means of an adhesive.

56. Apparatus according to any of Claims 47, 48, 49 or 53 in which the tobacco recovering means include a hood and a suction conduit for conveying loose tobacco out of such hood.

57. A self-supporting continuous composite tobacco sheet when made by apparatus according to any of Claims 26 to 56.

58. A self-supporting continuous composite tobacco sheet substantially as hereinbefore described with reference to the accompanying drawings.

59. Apparatus for forming a self-supporting continuous composite tobacco sheet substantially as hereinbefore described with reference to the accompanying drawings.

60. A method of forming a self-supporting continuous composite tobacco sheet substantially as hereinbefore described with reference to the accompanying drawings.

MARKS & CLERK,

Printed for Her Majesty's Stationery Office by Wickes & Andrews, Ltd., E.C.4. 684/2.—1955.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

FIG. 1

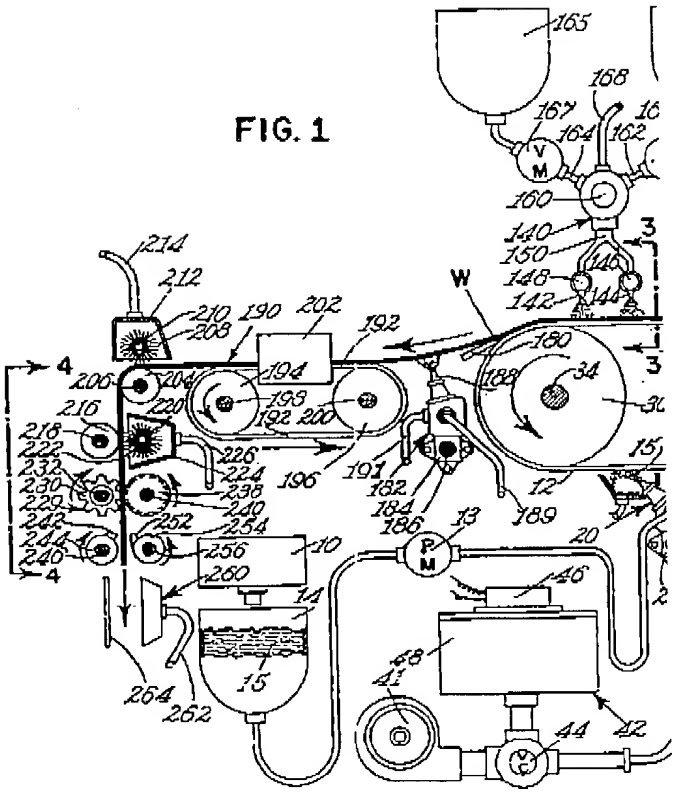


FIG. 5

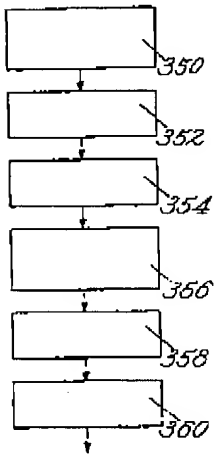


FIG. 6

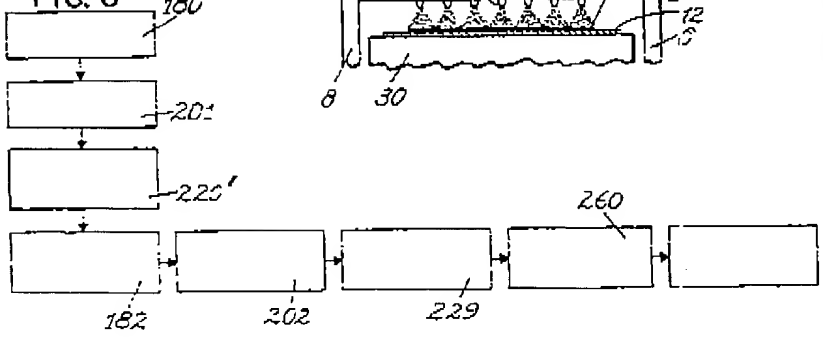
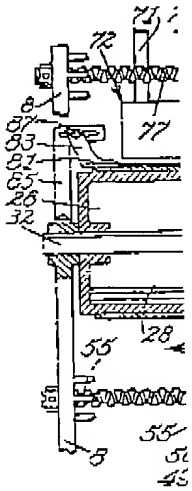


FIG. 3



727,903 COMPLETE SPECIFICATION
1 SHEET
This drawing is a reproduction of the Original on a reduced scale.

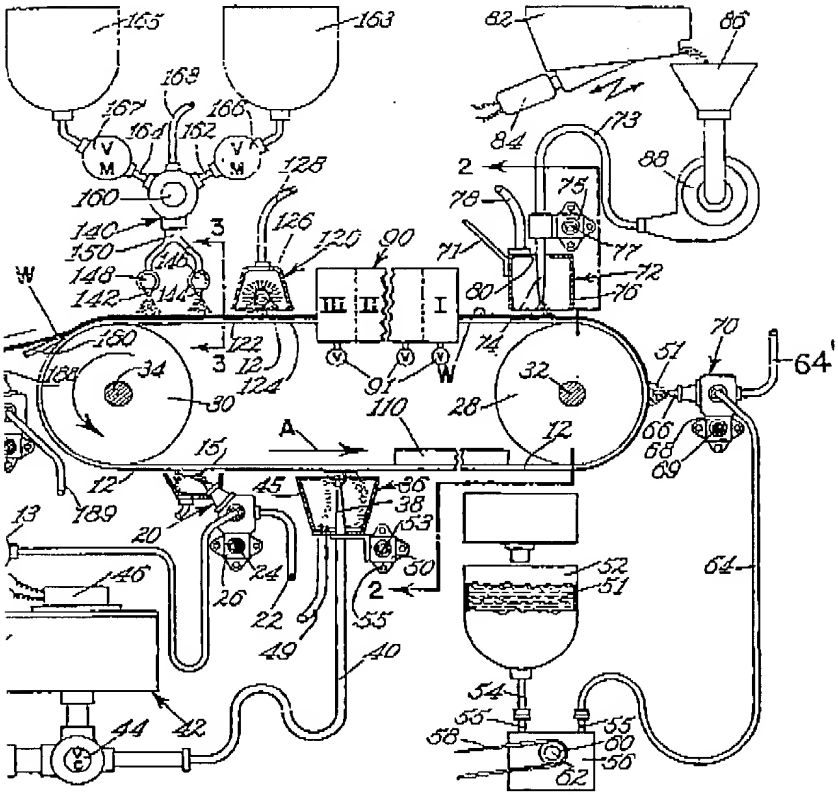
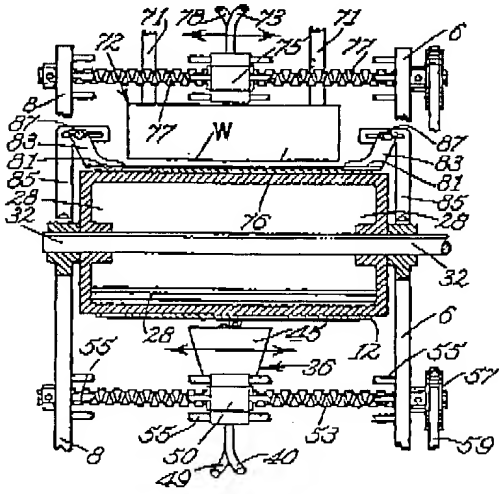


FIG. 2



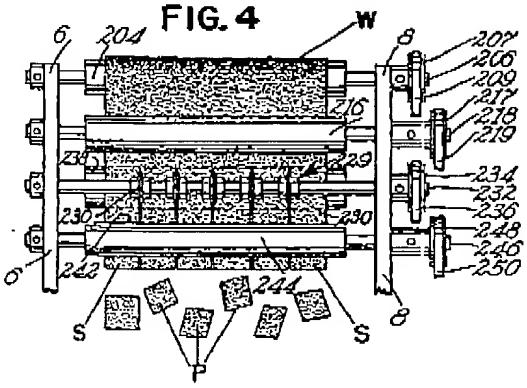


FIG. 4

727,903 COMPLETE SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale.

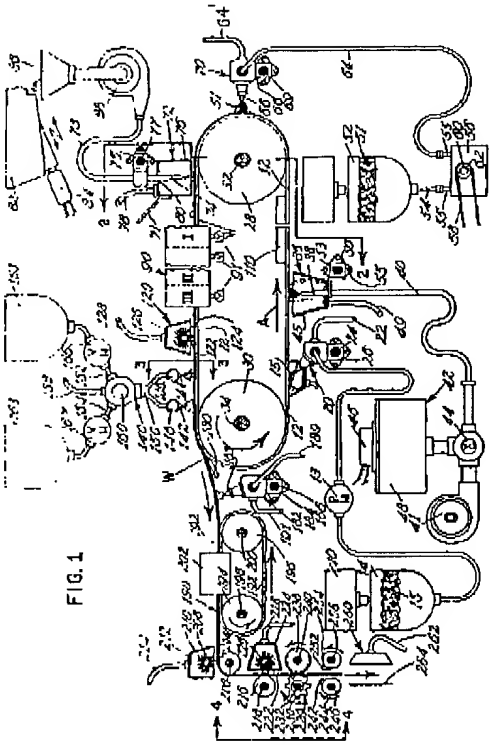


FIG. 1

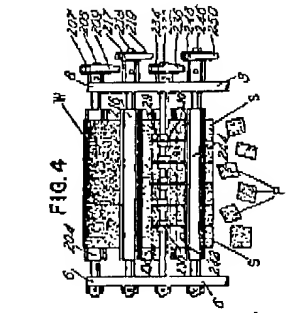


FIG. 4

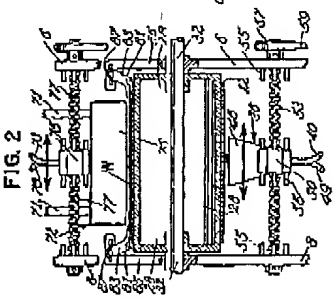


FIG. 2

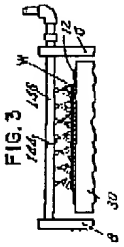


FIG. 3

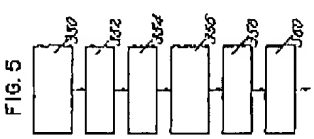


FIG. 5

FIG. 6